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New records of lichenicolous and lichenized fungi from Üzümdere Nature Park, Türkiye

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Abstract — Four species of lichenicolous fungi (*Clypeococcum epicrassum*, *Polycoccum cladoniae*, *Sphaerellothecium arnoldii*, and *Stigmidium* aff. *lecidellae*) and two species o f lichenized fungi (*Gyalolechia klementii* and *Parvoplaca servitiana*) are reported for the first time from Turkey. Comments on their morphological characters, habitats, and substrates are provided, together with macro- and microphotographs.

Key words — biodiversity, lichens, *Mycosphaerellaceae*, *Polycoccaceae*, *Teloschistaceae*

Introduction

Lichenized and lichenicolous fungal research in Turkey has increased considerably in the last 30 years. According to published floristic studies for various regions of Turkey, c. 1900 species of lichenized fungi are known from Turkey (John & Türk 2017; John & al. 2020). Numerous studies of lichenicolous fungi have been conducted recently (Hafellner & John 2006; Halıcı 2008; Halıcı & al. 2012; Kocakaya & al. 2015, 2016, 2018, 2020; John & al. 2020; Kocakaya 2021), resulting in about 200 lichenicolous fungi species recorded from Turkey.

In Turkey, Üzümdere Nature Park is located in the Middle Taurus Mountains between Konya and Antalya provinces. The study area has altitudes 247–1877 m a.s.l. (with Ulusivri Hill as the highest elevation). The different geomorphological features of the area and the humid environments created by

the Manavgat Stream create a wide range of different ecosystems and habitats in the study area, including forested ecosystems and rocky vegetation. Üzümdere Nature Park is under the influence of the Mediterranean climate in terms of natural vegetation (Uyar 2018).

Pinus brutia forest communities also include other trees from maquis elements, such as *Pistacia terebinthus* subsp. *palaestina*, *Olea europaea* var. *europaea*, *Laurus nobilis*, and *Arbutus andrachne*; and shrubs of *Calicotome villosa*, *Daphne sericea*, *Nerium oleander*, *Quercus coccifera*, and *Styrax officinalis* are found (Demirelma & Ertuğrul 2009). With so many different tree species and habitat diversity in the study area, we believe that there will be many more lichen and lichenicolous fungi to be found in future studies.

The aim of this paper is to contribute to knowledge of the lichen and lichenicolous fungi biodiversity of Turkey.

Material & methods

All species were collected from Üzümdere Nature Park (Antalya/Konya) during 2019–20. The specimens are stored in the Lichen Herbarium of Yozgat Bozok University (Science and Art Faculty), Yozgat, Turkey (UZD). The species were examined in Lugol's solution and KOH (10%) in adition to water, but spore measurements were made in KOH. All specimens were examined with a stereomicroscope (Olympus SZX16) and a light microscope (Olympus BX53). Macro- and microphotographs were taken with a digital microscope camera (Olympus DP72).

Taxonomy

Four species of lichenicolous fungi (*Clypeococcum epicrassum*, *Sphaerellothecium arnoldii*, *Polycoccum cladoniae*, and *Stigmidium* aff. *lecidellae*) and two taxa of lichenized fungi (*Gyalolechia klementii* and *Parvoplaca servitiana*) are reported as new records for Turkey. Each species is annotated with ecological data, and comparisons with published descriptions of the same species and with related species.

New records of lichenicolous fungi

Clypeococcum epicrassum (H. Olivier) Hafellner & Nav.-Ros., Bull. Soc. Linn. Provence 45: 423 (1994) FIG. 1A,B

Ascomata immersed, perithecioid, arising in groups often causing necrotic patches on the host thallus; 90–150 µm; wall dark brown, 10–11 µm. Hymenium colourless, I–. Asci 50–85 × 14–19 µm, (4–)8-spored. Ascospores ellipsoidal, brown, 1-septate, slightly constricted at the septum, 14–22 × 6–10 µm (n = 30).

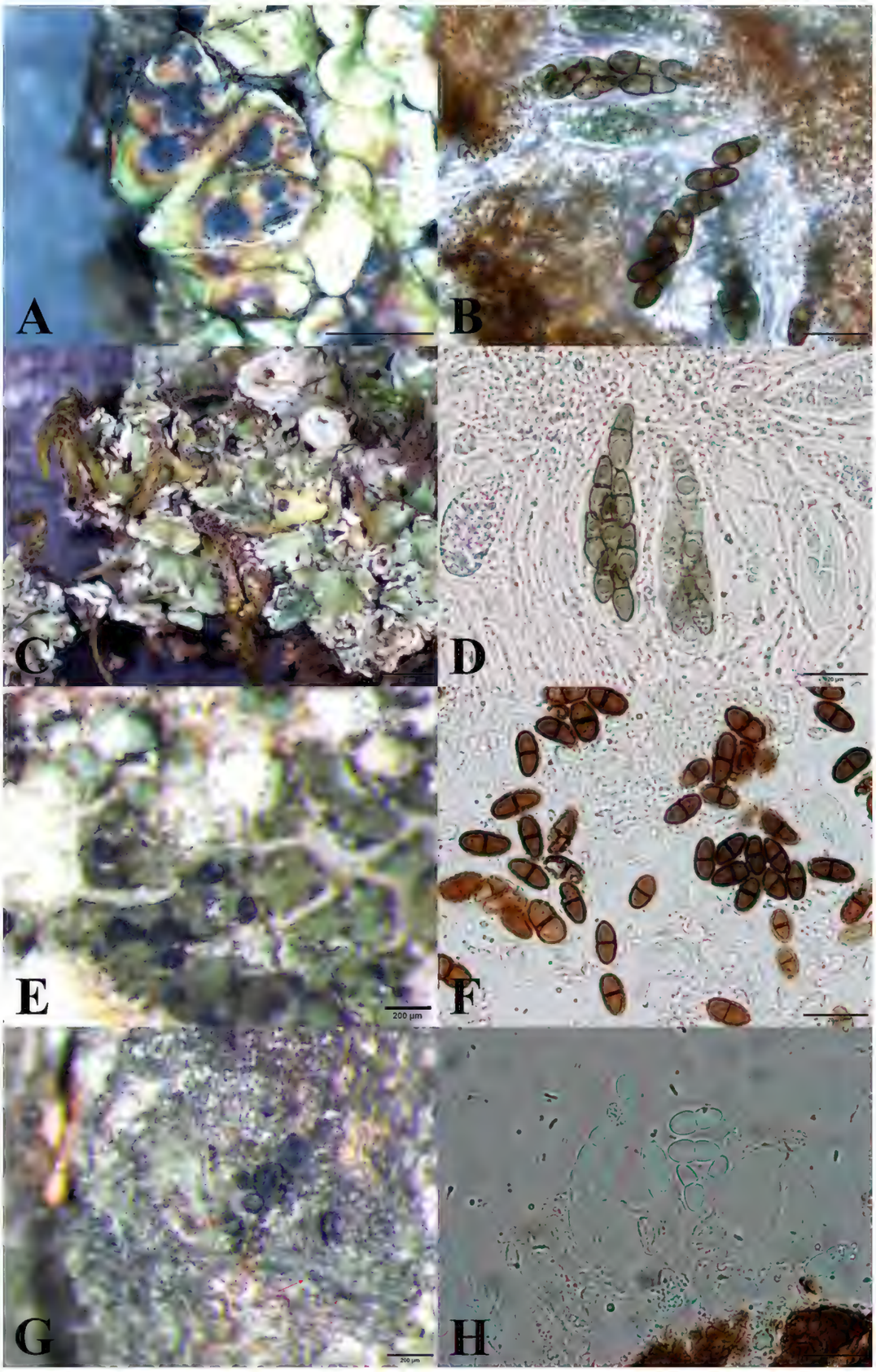

Fig. 1. ***Clypeococcum epicrassum*** (UZD 0.633) on *Squamarina cartilaginea*: A. Perithecia; B. Ascus and ascospores. ***Polycoccum cladoniae*** (UZD 0.632) on *Cladonia pyxidata*: C. Perithecia; D. Ascus and ascospores. ***Sphaerellothecium arnoldii*** (UZD 0.077) on *Lecania rabenhorstii*: E. Perithecia; F. Ascus and ascospores. ***Stigmidium* aff. *lecidellae*** (UZD 0.605) on *Lecidella elaeochroma*: G. Perithecia; H. Ascus and ascopores.

Specimen examined—**TURKEY. Antalya, İbradı**, Akseki–İbradı Road, 37.0459°N 313634°″E, 980 m, on thallus of *Squamarina cartilaginea* (With.) P. James, 14 September 2019, M. Kocakaya & M.U. Barak (UZD 0.633).

Comments— Our Turkish specimen's characters are coherent with the description given by Navarro-Rosines & al. (1994). According to Navarro-Rosines & al. (1994), this lichenicolous fungus has become widespread in Mediterranean and arid regions and it grows in the thallus of several species of *Squamarina*. This taxon causes clear spots in host thallus but apparently does not cause serious damage.

Only one *Clypeococcum* species, *C. hypocenomyces* D. Hawksw., has been previously reported from Turkey (Hafellner & John 2006; Halıcı & Candan 2007), growing on *Hypocenomyce scalaris* (Ach.) M. Choisy.

Distribution— *Clypeococcum epicrassum* has been previously reported from France, Greece (Navarro-Rosines & al. 1994), and Spain (Navarro-Rosines & al. 1994; Hafellner & Porcel 2003).

Polycoccum cladoniae Diederich & D. Hawksw., Trans. Brit. Mycol. Soc. 90(2): 297 (1988) Fig. 1c,d

Ascomata perithecioid, superficial, subglobose, ostiolate, black, 85–130 µm diam., wall dark brown, thickened near the ostiole, cells pseudoparenchymatous, 2–6 µm. hamathecium consisting of branched and anastomosing septate pseudoparaphyses. Asci clavate, bitunicate, thick-walled,containing 8 spores, 45–76 × 15–19 µm. Ascospores 1-septate, brown, verrucose, constricted at the septum, 16.5–21 × 5–8 µm (n = 30)

Specimen examined—**TURKEY. Antalya, İbradı**, Akseki–İbradı Road, 37.0832°N 31.6096°E, 980 m, on squamules of *Cladonia pyxidata* (L.) Hoffm., 14 September 2019, M. Kocakaya & M.U. Barak (UZD 0.632).

Comments— *Polycoccum cladoniae* is separated from other *Polycoccum* species by the size and shape of the ascomata and ascospores: ascomata 100–250 µm diam.; asci elongate-clavate, 40–60(–80) × 9–12(–14) µm; and ascospores ovoid, 1-septate, 13.5–16.5 × 6.5–8 (Hawksworth & Diederich 1988). The ascospores of our Turkish specimen are longer than in the original description (Hawksworth & Diederich 1988).

Polycoccum cladoniae is most similar to *P. microcarpum* Diederich & Etayo, which is also known to occur on *Cladonia* and with ornamented ascospores, but *P. cladoniae* has larger, more immersed ascomata, longer asci, and longer ascospores (Hawksworth & Diederich 1988).

Distribution— *P. cladoniae* has been previously reported from Germany and Austria (Hawksworth & Diederich 1988).

Sphaerellothecium arnoldii (A. Massal.) Hafellner, Fritschiana 94: 27 (2019) Fig. 1E,F

≡ *Tichothecium arnoldii* A. Massal., Misc. Lichenol.: 27 (1856).

= *Phaeospora arnoldii* Hepp, Flechten Eur.: no. 701. (1860).

≡ *Polycoccum arnoldii* (Hepp) D. Hawks., Bot. Not. 132(3): 289. (1979).

Ascomata 80–100 µm., superficial, globose. Hamathecial filaments 1.5–2.5 µm thick. Asci elongate clavate, 8-spored. Ascospores ellipsoid, 1-septate with unequal cells, brown, 12–16 × 5.5–7 µm (n = 25).

Specimen examined—**TURKEY. Antalya, Akseki**, Üzümdere, Üzümdere Village Road, 37.1318°N 31.7002°E, 650 m, on thallus of *Lecania rabenhorstii* (Hepp) Arnold, 13 September 2019, M. Kocakaya & M.U. Barak (UZD 0.077).

Comments— *Sphaerellothecium arnoldii* has been reported mostly from *Diploschistes* and *Rhizocarpon* hosts, but also from *Urceolaria*.

Our specimen growing on *Lecania rabenhorstii* has ascospores longer, measurement 12–16 × 5.5–7 µm, and asci wider, measurement 30–50 × 13–20 µm, than those reported by Hawksworth & Diederich (1988). The Turkish specimen causes bleaching on host thallus.

Distribution— *Sphaerellothecium arnoldii* has been previously reported from UK, Germany, Denmark, France, Luxembourg, Austria, Czechoslovakia, Italy, and Venezuela (Hawksworth & Diederich 1988; Santesson 1993; Berger & Priemetzhofer 2000; Atienza & al. 2003).

Stigmidium aff. lecidellae Triebel, Cl. Roux & Le Coeur, Canad. J. Bot. 73(4): 663 (1995) Fig. 1G,H

Ascomata black, superficial 60–110 µm. The periphyses, simple, 5–12 × 1–2.5 µm., Asci cylindrical, 8-spored, 40–60 × 15–23 µm. Ascospores 1-septate, colourless, oblong, 14–18 × 5–7 µm (n = 24).

Specimen examined—**TURKEY. Antalya, İbradı**, Akseki–İbradı Road, 37.0832°N 31.6096°E, 980 m, on thallus of *Lecidella elaeochroma*. 14 September 2019, M. Kocakaya & M.U. Barak (UZD 0.605).

Comments—The ascopores of our Turkish material are wider than in the original description (14–18 × 5–7 µm; Roux & al. 1995). *Stigmidium* aff. *lecidellae* was described on the apothecia of *Lecidella elaeochroma* (Ach.) M.

Choisy from France (Roux & al. 1995), having asci with 8 spores, broadly cylindrical or claviform, 22–36 × 8–13 µm, sessile or almost, fissitunicate, thick-walled; and ascospores colorless, (11–)12–13.8–15(–16) × 3–3.3–4 µm, oblong or long ellipsoidal.

Distribution— *Stigmidium* aff. *lecidellae* has previously been reported from France (Roux & al. 1995), Italy (Brackel 2008), and Russia (Urbanavichus & Urbanavichene 2014).

New records of lichenized fungi

Gyalolechia klementii (Kalb) Søchting, Frödén & Arup, Nordic J. Bot. 31(1): 71 (2013) Fig. 2A,B

Thallus pruinose, distinctly marginal lobes, yellow. Apothecia 0.6–1.4 mm diam, reddish brown, lecanorine. Hymenium up to 75 µm, asci 4-spored, 70–80 × 20–28 µm. Ascospores simple and broadly fusiform, with oil drops, 17–20 × 7–9.5 µm. (n = 30). Thallus and apothecia react with KOH (purple). Pycnidia not observed.

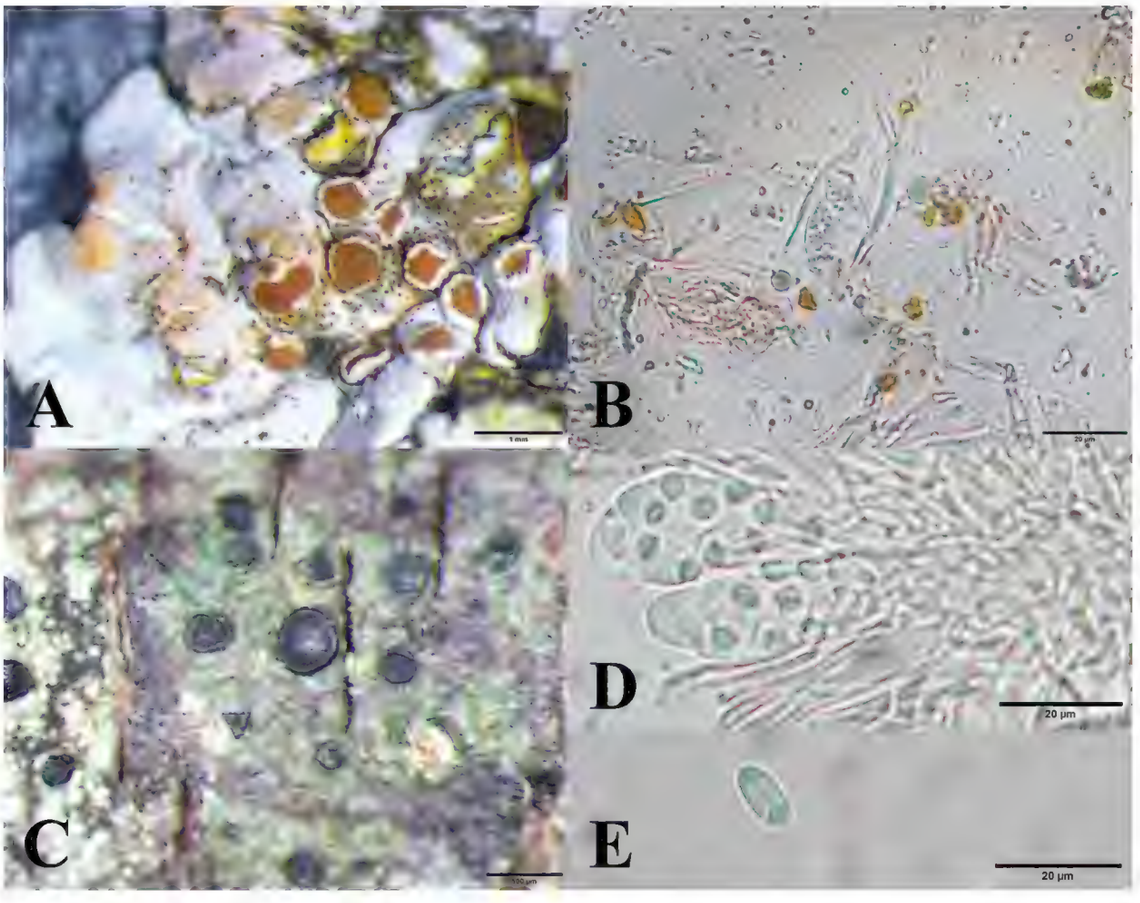

Fig. 2. ***Gyalolechia klementii*** (UZD 0.356): A. Thallus and apothecia; B. Ascospores. ***Parvoplaca servitiana*** (UZD 0.444): C. Thallus and apothecia; D. Ascus; E. Ascospore.

Specimens examined—**TURKEY. Antalya, İbradı**, Yukarı village, 37.1306°N 31.5976°E, 1280 m, on calcareous rocks, 14 July 2020, M. Kocakaya & M.U. Barak (UZD 0.356). **Konya, Taşkent**, Gevne valley, Göztaşı village, 36.8561°N 32.3525°E, 1558 m, on calcareous rocks, 28 July 2011, M. Kocakaya (Herb. Kocakaya 4465); Gevne valley, Tosmur village, 36.8867°N 32.3008°E, 1760 m, on calcareous rocks, 2 October 2011, M. Kocakaya (Herb. Kocakaya 4466).

Comments — Members of *Gyalolechia* are characterized by chemistry that is dominated by fragilin and commonly a yellow thallus (Arup & al. 2013). Thallus irregular. Apothecia numerous, scattered or contiguous, 0.7–1.3 mm wide. Hymenium 80 µm (Kalb 1970).

Gyalolechia klementii is easily separated from other species in the genus by the pruinose thallus and the ascospore type (Kalb 1970). There are nine species belonging to *Gyololechia* in Turkey (John & Türk 2017).

Distribution— *Gyalolechia klementii* has previously been reported from Spain (Kalb 1970, as *Fulgensia klemetii*) and Greece (Christensen 1995).

Parvoplaca servitiana (Szatala) Arup, Søchting & Frödén, Nordic J. Bot. 31(1): 49 (2013) Fig. 2c–e

Thallus thin, greyish green, apothecia black, biatorine, 0.2–0.6 mm diam, well-developed true exciple. Hymenium 70–100 µm. Asci broadly cylindrical, 30–40 × 10– 18 µm, 8-spored. Ascospores 13.5–15 × 5–7 µm and septum 5–8 µm (n = 30).

Specimen examined—**TURKEY. Antalya, Akseki**, Çınardibi, North of Çınardibi, on bark of *Laurus nobilis* L., 37.1805°N 31.7129°E, 1050 m, 13 September 2019, M. Kocakaya & M.U. Barak (UZD 0.444).

Comments— The species known as *Caloplaca servitiana* was transferred to the genus *Parvoplaca* by Arup & al. (2013). *Parvoplaca servitiana* is similar to *Caloplaca oleicola* (J. Steiner) van den Boom & Breuss but is clearly distinct. *Caloplaca oleicola* has a thin white thallus and biatorine apothecia with prosoplectenchymatous true exciple and without a thalline exciple (Vondrak & al. 2010), while *P. servitiana* has a well-developed true exciple. In the molecular study by Vondrak & al. (2012), *P. servitiana* was not closely related to any known European species with no known closely related lineages.

Distribution—*Parvoplaca servitiana* has previously been reported from Greece (Vondrak & al. 2012) and Italy (Ravera & Brunialti 2013).

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